

## Getting data about planets and moons – probes, landers and orbiters

You are going to plan the strategy to obtain useful information about the planet or moon that you have chosen as the best site for colonisation. You will need to decide what data to collect, and how to collect it. The data should help when planning how to establish the colonies.



*Beagle lander passing through the Martian atmosphere (Image: ESA)*

The information below will tell you about the range of approaches that are available to you to include in your plan.

### Satellites, landers and orbiters

David Ryan Smith of the National Centre for Space Science in Leicester has led the project to develop the Phoenix satellites. They have three distinct ways of collecting data, shown in Table 2.

**Table 2 Phoenix Satellite specification**

Method	Description
Orbiting above the chosen body ( <i>Orbiters</i> )	The satellite has cameras and other apparatus to remotely collect data above the body's surface.
Descending through the atmosphere of the chosen body	The satellite will have an opportunity to gather atmospheric data as it falls towards the surface of the body.
Surface Observations on chosen body ( <i>Landers</i> )	On landing on the surface of the body, the probe can gather more information.

### Sampling rates

The satellite can gather data continuously or by sampling (at varying time intervals). Continuous data collection can provide information about how factors may be changing over time, such as light intensity, temperature or wind speed. Sampling can be frequent (eg measurements taken every few seconds), or less frequent (eg measurements taken every few hours or days). Such sampling can also be used to track changes, but there will be gaps in between sampling events. For some factors this may not be important, such as monitoring the diurnal temperature range on a planet surface, or analysing the contents of an atmosphere, which may be thought of as relatively constant.

### Landers

Two types of surface landers are:

**Table 3**

Lander	What it does	Advantage	Disadvantage
Type 1	The probe splits into 4 identical mini probes on descent that can gather information from 4 distinct areas of the planet or moon surface.	The 4 mini probes can each gather data from 4 different places on the planet or moon surface.	Each of the mini probes cannot move from their landing site.
Type 2	One roving probe lands on the planet or moon surface.	The probe can be remote controlled from Earth and sent to gather data over the planet or moon surface.	The roving probe can only travel a few hundred metres each day before needing to recharge its solar batteries.

### Types of sensors

Many important factors can be measured or observed using probes and sensors.

**Table 4**

Vehicle	Sensor type	Description
Orbiters	Visible spectrum and IR spectrum imaging	Topography (landscape) and appearance, mapping. Hot-spot mapping (eg hot springs).
	Spectral analysis	Chemical composition, surface and atmosphere. Geology.
	Radiation sensor	EMR spectrum of planet or moon atmosphere.
	Laser ranging equipment	Topography.
	Accelerometer	Gravitational pull.
	Temperature	Temperature profile on decent through atmosphere.
Decenders	Atmospheric pressure	Pressure profile on descent.
	Solar sensors	Solar radiation profile on descent.
	Mass spectrometer	Atmospheric composition on descent.
	Impact sensor	Type of surface at landing site.
	Surface material analyser	Composition of surface materials.
Landers	Solar sensor	Solar radiation strength.
	Temperature	Temperature at landing site.
	Pressure	Pressure at landing site.
	Mass spectrometer	Atmospheric composition at landing site.
	Visible and IR spectrum imaging	Topography (landscape) and appearance.
	Radiation sensors	Radiation spectrum and levels on surface.

## Planning the mission

Your challenge is to design a space mission. Your specific job is to decide what factors you wish to investigate on your chosen colonisation site. You do **not** have a totally free choice to use any of the approaches mentioned above, since there are limits to how much equipment you can send through space.

You can choose any two of

- orbiter
- descender
- lander



*Images of the Huygens probe descending onto Titan's surface*

*(Assume, for instance, that an orbiter can become a descender or lander, or that a descender can become a lander.)*

If you choose a lander it must be **either** a Type 1 (probe splits into four separate static units prior to impact) **or** a Type 2 (probe lands as a single mobile unit).

In total you can only send six sensors. More than this and the fuel requirements at lift off become too great.

Produce a plan, explaining:

- what factors you are going to investigate, and why these are important in terms of the successful colonisation of a planet or moon in the future
- what type of probe(s) will you send
- what six sensors you will include
- what data you plan to collect, and how, and why this data is important for planning future trips to colonise the planet or moon
- the amount of precision you need in collecting data with each of the six sensors, and why.